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EXAMINER
CORBETT, JOHN M

ART UNIT	PAPER NUMBER
2882	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

	Application No.	Applicant(s)
Office Action Summary	10/506,716	HOGHOJ ET AL.
	Examiner	Art Unit	
	John M. Corbett	2882	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-44* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-44* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on *07 September 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152..

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☒ All b)☐ Some * c)☐ None of:

      1.☒ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8/4/2005*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1.   Claim 30 is objected to because of the following informalities:

Claim 11, in line 1-2, "The optical assembly claim 1, wherein" perhaps

should read as "The optical assembly **of** claim 1, wherein".

Claim 30, in line 3, "roughness lower than 10 rms" perhaps should read as

"roughness lower than 10 **angstroms** rms".

Claim 34, in line 1-2, "The method the claim 32, further comprising"

perhaps should read as "The method **of** claim 32, further comprising".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form

the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2.   Claims 1-7, 9, 11, 13 and 15 are rejected under 35 U.S.C. 102(b) as being

anticipated by Gutman (5,799,056).

With respect to claims 1, 3-4, 9, 11, 13 and 15, Gutman teaches a laterally graded reflective multilayer (See Abstract and Col. 4 line 3-12) having a reflecting surface to reflect incident X-rays (See Col. 2 line 8-11) under low incidence angles (See Col. 2 line 16-31 and 57 – 64) while producing two-dimensional optical effect by a single reflection of incident rays on the optical assembly (See Fig. 2 and proposed applications as noted in Col. 2 line 65 – Col. 3 line 10), the reflecting surface comprising a single surface conformed along two curvatures corresponding to two different directions, the surface being a smooth surface. (See Col. 4 line 45-47 where an aspherical surface is used. An aspherical surface is one that "departs slightly from the spherical form", hence it is a near spherical surface that necessarily is a single smooth surface that conforms along two curvatures corresponding to two different directions, the θ and ϕ directions in spherical coordinates. Note: The examiner has used the applicant's definition of "low incidence angle" as defined on page 1 line 5-8, where low incidence angle refers to incidence angles lower than a value of **about 10 degrees**, the angle of incidence being defined with respect to the reflecting surface. In light of the Bragg condition and the range of wavelengths that can be reflected as cited above necessitates that this low angle of incidence angle condition is met.)

With respect to claims 2 and 5, Gutman further teaches the θ and ϕ directions in spherical coordinates are orthogonal, either one of which can be chosen to be either of the two preferred directions, the sagital and meridional directions of the incident X-rays. Once meridional direction is selected, Gutman further teaches how to apply a laterally

graded multilayer to the aspherical substrate, which can include any direction that has

been selected to be the meridional direction. (See Col. 5 line 43-50)

With respect to claim 6, Gutman further teaches the multilayer is a depth

graded multilayer. (See Col. 4 line 3-6 and Fig. 3)

With respect to claim 7, Gutman further teaches the reflecting surface is adapted

to reflect rays of Cu-K α peaks. (See Col.5 line 54 – Col. 6 line 3 where Cu-K α radiation

is used to characterize the d spacing of the optical flat. Since the same multilayers are

being formed on the curved surface, it would have been obvious to Cu-K α radiation

with these curved optical elements.)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3.   Claims 8, 12, 16 and 20-25 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Gutman (5,799,056) as applied to claim 1 above, and further in view

of Doumas (5,142,561).

With respect to claims 8, 12 and 16, Gutman teaches all of the limitations of

claim 1. Gutman further teaches a method for coating a curved substrate with a laterally

graded multilayer structure, which can be applied so that the original curvature of the

substrate is maintained. (See Col. 2 line 36-43, Col. 4 line 51-52, Col. 4 line 61 – Col. 5

line7, Col. 5 line 26-50 and Fig. 6) Gutman further teaches a lateral grading of the

multilayer structure across the surface of the optic allows for the "d spacing" to change

across the surface therefore x-rays of the same wavelength can be reflected from a

larger area of the surface, even where the angle of incidence changes across the

surface. (See Col. 2 line 8-13) This allows for an increase in the reflected intensity of the

x-rays at a given wavelength over that of the traditional shaped optic. Applications for

this optics include x-ray lithography systems. (Col. 3 line 2-4) Gutman fails to teach the

first and second curvatures define a circle and the reflecting surface has a geometry of

substantially toroidal shape.

Doumas teaches an X-ray lithography optical system has an elongated concave

scanning mirror that has a reflecting surface of part toroidal configuration having a first

radius of curvature coincident with that of a torus of which the mirror is part and spaced

opposite first and second ends having a second radius of curvature, different from the

first radius of curvature, coincident with that of the circle which generates the torus.

(See Abstract and Fig. 2) Doumas further teaches "The shape of the beam spot will

have implications on the throughput of the system, but does not affect the lithographic line resolution of the system. That is, how many wafers can be irradiated in a given period of time. For this reason, the mirror design has been optimized to have good divergence properties at the expense of a non-rectangular beam spot shape, and therefore lower throughput." (See Col. 2 line 34-42) Thus increasing the output intensity of the optic will result in increase throughput of the lithography system.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the toroidal optic of Doumas with a laterally graded multilayer along the meridian of the optic of Gutman since a person would have been motivated to have an optic that yielded a greater output intensity thus allowing for faster exposures and thus higher output from the lithography device.

With respect to claim 20, Doumas further teaches, reflecting surface has a sagital curvature radius of less than 20 mm. (See Col. 4 line 11-26 for specifications on four embodiments where the sagital curvature radius ranges from 16 cm to 23 cm. Coating of the surface with a laterally graded multilayer would increase intensity of the reflected beam due to the increased surface area contributing to the reflection while maintaining the original curvature of the substrate, i.e. original reflecting surface.)

With respect to claims 21-22 and 24-25, Doumas further teaches one window that opaque to X-rays, the at least one window having an aperture therein and being associated an output of the optical assembly in order control a flux of the optical

assembly. This opaque window is a mask for permitting a predetermined pattern of X-rays to impinge on the photoresist and substantially blocking all other X-rays. (See Col. 4 line 40-47 and Fig. 1 item "mask 6") Doumas is silent as to the removablity, inter-changeability or translation of the mask between the source in and the sample.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the mask removable and translatable since a person would have been motivated to have a system in which the mask would be removable for conducting maintenance or exchanged with a different mask with a different predetermined pattern to modify the output beam and translatable to change the magnification of mask image. Exchanging masks effectively changes output cross-section, the size and shape of the aperture thereby adjusting the reflected flux in a controlled manner. Translating the mask changes the magnification of the mask image resulting in a flux/divergence compromise of the radiation.

With respect to claims 21 and 23, Doumas further at least one window that opaque to X-rays, the at least one window having an aperture therein and being associated with an input of the optical assembly in order control a flux of the optical assembly. The aperture is located at the input cross-section, and the size and the shape of said aperture can be adjusted in order to control the an incident flux. (See Col. 1 line 36-44 where the "small fraction of these photons are accepted into the beamline" is a result of initial shielding at the entrance to the beamline and can be adjusted by repositioning the shielding during maintenance or beamline port setup.)

4.   Claims 8-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Gutman (5,799,056) as applied to claim 1 above, and further in view of Chen (6,285,506

B1).

        With respect to claims 8-19, Gutman teaches all of the limitations of claim 1.

Gutman further teaches a method for coating a curved substrate with a laterally graded

multilayer structure, which can be applied so that the original curvature of the substrate

is maintained as noted above. The preferred substrates can be one of silicon wafers,

mica, quartz, zerodur, sapphire, germanium, Pyrex, silicon carbide or other like

substances. (See Col. 4 line 38-40) Gutman further teaches a lateral grading of the

multilayer structure across the surface of the optic allows for the "d spacing" to change

across the surface, therefore x-rays of the same wavelength can be reflected from a

larger area of the surface, even where the angle of incidence changes across the

surface. (See Col. 2 line 8-13) This allows for an increase in the reflected intensity of the

x-rays at a given wavelength over that of the traditional bent crystal optic. The Gutman

fails to teach a first one of the two curvatures defines a circle, first of the two curvatures

defines a curve different from a circle, the first curvature defines an ellipse or a

parabola, a second one of the two curvatures defines circle, a second one of the two

curvatures defines a curve different from a circle, the second curvature defines an

ellipse or a parabola, the reflecting surface has a geometry of substantially toroidal

shape, the reflecting surface has a geometry of substantially paraboloidal shape, the

reflecting surface has a geometry of substantially ellipsoidal shape.

Chen teaches an optically curved element and a method for fabricating a doubly curved optically elements curved with a smooth surface that can be fabricated in any preselected geometry to comprise one of a convex surface, a concave surface, a toroidal surface, a parabolic surface, a spherical surface or an ellipsoidal surface. (See Col. 2 line 42-47 where doubly curve surface is not restricted to be of the same type in different directions. For example, it can have an elliptical curve in one direction and parabolic curve in the orthogonal direction of the surface.) These surfaces can also comprise "other optical surfaces". (See Col. 4 line 64-67 where other optical surfaces are curved surfaces different from an circle, an ellipse or a parabola.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the doubly curved optics of Chen with a laterally graded multilayer along the meridian direction since a person would have been motivated to have an optic that yielded a greater output intensity thus allowing, for example, for faster exposures and thus higher output from a lithography device.

5.   Claims 26-29, 31-37 and 41-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosser (GB 2217036 A) and further in view of Gutman (5,799,056).

With respect to claim 26, Rosser teaches a method of manufacturing an optical assembly of coating surface with a multi-layer coating (See page 14 line 33-34) to form a reflecting surface to reflect incident X-rays under low incidence angles (See page 7 line 31 – page 8 line 1) while producing a two-dimensional optical effect (See Fig. 6 and

22), the reflecting surface comprising a single surface conformed along two curvatures corresponding to two different directions (See Abstract and Fig. 1), the method comprising: providing a substrate having a curvature along a first direction; coating the substrate; and curving the substrate along a second direction different than the first direction. (See page 7 line 11-21) Rosser fails to teach the multilayer coating is laterally graded.

Gutman teaches a method for forming laterally graded multilayer on a variety of substrates to include Pyrex, a borosilicate glass, to form optical elements for X-rays as noted above. Gutman further teaches a lateral grading of the multilayer structure across the surface of the optic allows for the "d spacing" to change across the surface therefore x-rays of the same wavelength can be reflected from a larger area of the surface, even where the angle of incidence changes across the surface. (See Col. 2 line 8-13) This allows for an increase in the reflected intensity of the x-rays at a given wavelength over that of the traditional shaped optic.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Rosser which includes coating the glass substrate with a multilayer to include the method of Gutman where the multilayer is laterally grade in the meridional direction of the doubly curve surface since a person would have been motivated to have an optic that yielded a greater output intensity by utilizing a large reflecting surface.

With respect to claims 27, 29, 31-32 and 34, Rosser further teaches that the glass tube is cut longitudinally so that the substrate has a shape of an open cylinder before coating as is apparent in the finished product in Fig 1. Since the final mirrors are longer than wide, the meridional direction is taken along the z direction of the glass cylinder and therefore the sagital direction of the substrate already has curvature corresponding to the initial curvature of the tube where glass tube has circular transversal cross-section. The second curvature is then produced on the meridional direction. (See Fig. 1 and 2)

With respect to claim 28, Rosser further teaches the curvature of the substrate corresponding to the sagital direction of the optical assembly defines a radius of curvature which is less than 20 mm. (See Table 1 on page 13)

With respect to claim 30, Gutman further teaches the root mean square surface roughness of the substrate will range from 0.5 to 20 angstroms, measured at intervals of about 10 angstroms. (See Col. 4 line 32-40)

With respect to claim 33, Gutman further teaches forming laterally graded multilayer on a variety of substrates to include Pyrex, a borosilicate glass.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use borosilicate glass 3.3 type in place of Pyrex since it has been held that selection of a known material based on its suitability for its intended use

is obvious, in re *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65

USPQ 297 (1945).

    With respect to claim 35, Rosser in view of Gutman is silent as to the order of

cutting in order to dimension the optical assembly in length and cutting the glass tube

along the longitudinal direction.

    At the time the invention was made, it would have been an obvious matter of

design choice to a person of ordinary skill in the art to cut in order to dimension the

optical assembly in length after cutting the glass tube along the longitudinal direction.

One of ordinary skill in the art, furthermore, would have expected the optical assembly

to perform equally well with cutting in order to dimension the optical assembly in length

before cutting the glass tube along the longitudinal direction because the resulting

product would be unchanged, an open glass cylinder cut to a desired length.

    With respect to claim 36, Rosser in view of Gutman teaches all of the limitations

of claim 26. Rosser fails to teach coating the substrate is performed to achieve a

multilayer before curving the substrate.

    Gutman teaches coating a flat optical element with thin multilayer whose spacing

has been calculated to achieve the desired effect on a beam of x-rays for an element

with a known curvature. Then the deviation of the actual d spacing from the calculated

multilayer will be found. Using this information, an adjusted curvature for an element

can be calculated to compensate for the error in d spacing. (Col. 2 line 49-56 and Col. 5 line 8-18)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to employ the method of Gutman to initially coat the open cylinder substrate of Rosser with a laterally graded multilayer in the meridional direction (the direction that is flat since it is along the z-axis of the cylinder) before curving the substrate along the second curvature since a person would have been motivated to have the ability to carefully examine the quality of the applied laterally graded multilayer by directly measuring the lateral grading on in the un-curved dimension so that the ideal curvature for that applied coating could be calculated and then applied to the glass substrate insuring the highest possible quality of the final optic product.

With respect to claim 37, Rosser and Gutman both further teach the substrate is curved in order conform to a predetermined geometry before the coating step. (See Rosser Page 7 line 13-18 and claims 18-20 where the coating is applied subsequent to the curving and see Gutman Col. 4 line 64 – Col. 5 line 7)

With respect to claim 41, Rosser teaches a device for generating and conditioning X-rays for angle-dispersive X-ray reflectometry, the device comprising: an optical assembly comprising a reflective multilayer (See page 14 line 33-34) having a reflecting surface to reflect incident X-rays (See Fig. 1 and Abstract) under low incident angles (See page 7 line 31 – page 8 line 1) while producing a two dimension (See Fig. 4

item 50al optical effect (See Fig. 6 and 22), the reflecting surface comprising a single

surface conformed along two curvatures corresponding to two different directions (See

Abstract and Fig. 1); a source of the incident X-rays coupled to the optical assembly

(See page 7 line 22-24 and Fig. 4 item 40) so the incident X-rays are conditioned along

two dimensions to adapt a beam emitted by the source destination of a sample, with the

X-rays having different angles of incidence on the sample. (See page 7 line 24-27 and

Fig. 4 item 50) Rosser fails to teach the multilayer coating is laterally graded.

Gutman teaches a method for forming laterally graded multilayer on a variety of

substrates to include Pyrex, a borosilicate glass, to form optical elements for X-rays as

noted above. Gutman further teaches a lateral grading of the multilayer structure across

the surface of the optic allows for the "d spacing" to change across the surface therefore

x-rays of the same wavelength can be reflected from a larger area of the surface, even

where the angle of incidence changes across the surface. (See Col. 2 line 8-13) This

allows for an increase in the reflected intensity of the x-rays at a given wavelength over

that of the traditional shaped optic.

It would have been obvious to one of ordinary skill in the art at the time the

invention was made to modify the optic of Rosser which includes a multilayer coating,

with the lateral grading of the multilayer of Gutman since a person would have been

motivated to have an optic that yielded a greater output intensity by utilizing a large

reflecting surface.

With respect to claim 42, Rosser further teaches the dispersion of angle incidences the sample corresponds substantially to an angular dispersion along a sagital dimension of the beam reflected by the optical assembly. (See Page 4 line 23-32 and Fig. 3)

With respect to claim 43, Rosser further teaches the optical assembly is directed relative to the sample so that the normal in a center region of the optical assembly is approximately parallel to the surface the sample. (See Fig. 4 and 5. Two views are given rotated by 90 degrees. Clearly, in these two views, the optical assembly is directed relative to the sample so that the normal in a center region of the optical assembly is approximately parallel to the surface the sample (item 50). Note in Fig. 4 the incident and reflected angles are exaggerated from the described 1.5 degree angle in the specification.)

With respect to claim 44, Rosser further teaches that a limiting feature to the optical element is the elastic limit of the glass. (See Page 4 line 17-19) No limit is placed on the length of the glass in the meridional direction. Also, no limits are placed on the type of multilayer material to be used.

Gutman teaches that the that each layer of the multilayer is made up of two separate layers of different materials: one with relatively high atomic number, or Z, and a second with relatively low atomic number. No limit is placed on which of the well-known multilayer combinations can be used. Gutman further teaches that high quality

graded multilayers can be produced of "extremely high precision". (See Abstract and Col.4 line 51 – Col. 6 line 14)

At the time the invention was made, it would have been an obvious matter of design choice to a person of ordinary skill in the art to position the optical assembly so dispersion in angles of incidence of the X-rays on the sample is greater than 2 degrees, the sample being positioned at least 15 cm from the optical assembly provides an advantage since a person would have been motivated to engineer the optical assembly with the desired meridional and sagital divergences taking into consideration the incident beam's initial shape and divergence characteristics and desired sample placement distance.

6.   Claims 38-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosser (GB 2217036 A) in view of Gutman (5,799,056) and further in view of Schuster et al. (Laterally Graded Multilayer Optics for X-Ray Analysis, SPIE Vol. 3767, Jul 1999, Page 183-198).

With respect to claim 38, Rosser in view of Gutman teaches all of the limitations of claim 26. Gutman further teaches each layer of the multilayer is made up of two separate layers of different materials: one with relatively high atomic number, or Z, and a second with relatively low atomic number. No limit is placed on which of the well-known multilayer combinations can be used. The high quality graded multilayers can be produced of "extremely high precision". (See Abstract and Col.4 line 51 – Col. 6 line 14)

Rosser in view of Gutman fails to explicitly teach the use of $Ni\backslash B_4C$ or $Ni\backslash C$ as

multilayers in which the Nickel layers effective act as Cu K-β filters.

Schuster et al. teaches the use of laterally graded multilayer mirrors that are

composed of $Ni\backslash B_4C$ multilayer that can be used in x-ray diffractometer that effectively

suppress Cu K-β radiation. (See page 194 where a reflectivity of 93% is demonstrated

for Cu K-α radiation and only 0.64% for Cu K-β for a Ni/C multilayer) The Nickel is thus

coupled to the optical assembly.

It would have been obvious to one of ordinary skill in the art at the time the

invention was made to modify the method of Rosser in view of Gutman as applied to

claim 26 above to form an optic that utilized the greater output intensity obtained with

the large effective area of the doubly curved laterally graded multilayer to include the

method of Schuster et al. to use of a $Ni\backslash B_4C$ or $Ni\backslash C$ multilayer coating to effectively

suppressed the undesirable Cu K-β radiation for use in a diffractometer since a person

would have been motivated to have an optic that had increased intensity thus

shortening analysis times while improving the quality of the diffraction data by reducing

Cu K-α "twin diffraction peaks" that result from narrow difference in wavelength between

Cu K-α and Cu K-β x-rays.

With respect to claim 39, Rosser in view of Gutman places no limit on the

thickness of each multilayer or the number of multilayers. Schuster et al. discloses the

use of a d-spacing of $d_a = d_b = 2.233$ nm and 100 layers resulting in a total thickness of

223.3 nm = 0.2233 microns, half of that thickness is Nickel which acts as an effective

filter for Cu K-β x-rays.

At the time the invention was made, it would have been an obvious matter of

design choice to a person of ordinary skill in the art to engineer an optical element with

the desired effective thickness of the Nickel in the layers to be 10 microns (total

multilayer thickness is sum of thickness of Nickel layers plus the sum of the thickness of

the B_4C or C layers) because the applicant stated the intended purpose of the 10

micron Nickel purpose was to "attenuate the copper K-β peak (0.139 nm) by a factor of

8 while maintaining sufficient transmission for the K-α peaks (greater than 60%)" which

is accomplished by the use of Ni as one of the materials used in the multilayer. The

applicant failed to claim that the Nickel filter was composed of a single crystal, film or foil

and failed to claim a multilayer combination.

With respect to claim 40, Rosser in view of Gutman and further in view of

Schuster et al. disclose a method of fabricating the filter by depositing a layer of filtering

material on the multilayer (successive layers of Nickel are deposited on the multilayer

as it is made and if desired can be the final layer deposited), the filtering material having

a coating thickness approximately given by the following relationship: $d = (e \sin\theta)$

wherein e is a required filter optical thickness and theta is an angle of incidence. (The

condition, effective thickness of Nickel in Nickel layer = $d_{Ni} * \sin\theta$ where d_{Ni} is the d-

spacing of the Nickel layer, is met each time an x-ray is transmitted through a Nickel

layer. The "required filter optical thickness e" is just the mean number of Nickel layers

penetrated before a Bragg reflection occurs times the mean thickness of the Nickel

layers.)

Conclusion

7.   The prior art made of record and not relied upon is considered pertinent to

applicant's disclosure.

        a.   Ulmer et al., Production and Performance of Multilayer Coated Conic

        Sections, Proc. SPIE Vol. 4496, pg 127-133, July 2001, discloses a method of

        producing a high quality (about 0.5 nm) smooth truncated cone x-ray mirrors. The

        mirror has several layers including a uniform Si/W multilayer. The process

        involves sputter depositing the multilayer on a mandrel (master) that is the

        complement of the figure of the optic that is desired. A nickel mirror is then

        electro-deposited on the coated mandrel. The electroformed mirror is then

        removed with the multilayer intact as a coating on the reflective nickel coating

        inside. The x-ray mirror has a reflecting surface to reflect x-rays at a low angle of

        incidence. Since the mirror has the shape of a smooth truncated cone that is the

        complement of the mandrel (initial substrate), it necessarily has a curvature it two

        different directions. (See examiner's notes on Fig.1 where two orthogonal planes

        intersecting the cone necessarily for two ellipses.) The focusing of the mirror in

        two dimensions is a two dimensional optical effect. Ulmer et al. further suggests

        applying a method of graded d-spacing multilayer-coated to mirrors of this

mandrel. Ulmer et al. does not explicitly disclose a method for accomplishing this task.

b.   Ulmer et al., The Fabrication of Wolter I Multilayer Coated Optics via Electroforming: an update, SPIE Vol. 3773, July 1999, page 113-121, discloses additional details on the development of a method of making multilayer curved x-ray optics that are coated with Nickel.

c.   Romaine et al., Multilayer Optics for Hard X-ray Astronomy, SPIE Vol. 4138, Nov 2000, page 120-125, discloses a depth graded-d W/Si multilayer deposited on thermally formed DESAG glass and Duran glass cylinder. The optic was thermally formed to form a 120-degree segment of a conical Wolter I type optic for use in x-ray astronomy.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John M. Corbett whose telephone number is (571) 272-8284. The examiner can normally be reached on M-F 8 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward J. Glick can be reached on (571) 272-2490. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

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